

# CHAPTER I

## INTRODUCTION



During the last decade, the study of mechanical properties of mixed plastics received public attention for two main reasons:

1. The first one concerns the development of materials for new and more technical applications. The different properties of each polymer are combined together to create new products with improved properties.
2. The second one is the use of mixed plastics in the field of recycling post-consumer wastes. In this case, economical costs linked to the separating steps could be decreased and recycling of plastic wastes becomes more profitable.

The mechanical recycling of post-consumer plastics remains one of the preferred recycling options for ecological and energy reasons, as far as this way is economically profitable. The use of mixed post-consumer plastics is undoubtedly a part of the solution to this difficult problem, at the same level as chemical and energetic recycling.

Household plastic wastes comprise very dissimilar generic polymers. The polyolefins are the main components being about 60–70 wt.%, other polymers such as PS, PET and PVC make up the remaining part of the composition with possibly minor quantities of polyamide, polycarbonate, acrylic polymers [1].

Base on worldwide consumption, polyethylene (PE) and polypropylene (PP) are the first and second highest volume thermoplastics. PE and PP are low-cost materials providing good mechanical properties for moderate temperature applications. It is known that homopolymer polypropylene predominately used for applications requiring high modulus but shows unsatisfactory impact strength at low

temperatures, owing to its relatively high glass transition temperature and its large spherulite dimension. In contrast, PE has a ductile-to-brittle transition temperature well below that of PP. Combining the low temperature ductility of PE with the high stiffness of PP has the potential to significantly expand the applications base of these two polyolefins.

Unfortunately, the incompatibility between PE and PP has already been reported by various authors[2]. The strong phase separation leading to a coarse phase structure and the low interfacial adhesion between the phases is responsible for a decrease in mechanical properties especially related to its morphology, including impact strength, strain at break and ductile to brittle transition. According to Shanks [3] the immiscibility between the phases makes the rule of mixtures ineffective in predicting some properties of interest.

To overcome this difficulty, the usages of various coupling agents have been reported. Incorporating a compatibilizer into a multiphase system generally leads to a fine phase structure and enhanced interfacial adhesion. Amongst others [4-6], Yang [7] showed that the addition of a commercial ethylene/propylene block copolymer improved the ductility of LDPE/PP blends, particularly for PP rich blends. Bertin, J.J et.al [8] studied and characterized virgin and recycled LDPE/PP blends and the use of compatibilizing agents, such as ethylene-propylene-diene monomer copolymer (EPDM) or PE-g (2-methyl-1,3-butadiene)graft copolymer, to enhance their impact strength and elongation at break. Although this may solve the compatibility problem, the use of compatibilizers adds cost to the recycled product, usually resulting in loss of interest from the recycling sector.

In this present work, we try to synthesized the low cost and effective compatibilizer that can improve the mechanical properties of PP/PE blend which can be applied to compatibilised recycled PE/PP mixtures in polymer waste streams.

Consequently of adding Ziegler-Natta PE/PP block copolymer synthesized by diisocyanate compatibilizers is the ability to reinforce of polyethylene-polypropylene mixtures as it is expected thermodynamically to sit at the interface between the two components. Evaluate the morphology, thermal properties and tensile properties of PP/PE blends.

### **1.1 The Objective of This Thesis**

To improve the reinforcement of polypropylene/polyethylene mixtures by blending with compatibilizers which are synthesized via diisocyanate.

### **1.2 The Scope of This Thesis**

- 1.2.1 Synthesize the terminated hydroxy end group polypropylene and polyethylene and characterize the end chain group by  $^1\text{H}$  NMR.
- 1.2.2 Synthesize PP-block-PE by using diisocyanate and prove that a block polymer has been made by  $^{13}\text{C}$ -NMR and SEM.
- 1.2.3 Blending the compatibilizers to polypropylene mixed polyethylene. Characterize the polymer blends by using differential scanning calorimetry (DSC), dynamic mechanical properties (DMA), scanning electron microscope (SEM), gel permeation chromatography (GPC) techniques and tensile testing machine.